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Wood Charcoal Analysis from Coan Hall (44NB11)

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Ongoing excavations by the University of Tennessee, Knoxville and volunteers at Coan Hall (44NB11) are shedding new light on the lives of 17th-century English colonists on the Northern Neck of Virginia. Coan Hall was home to Colonel John Mottrom and his family. Mottrom was one of the first European settlers in the Northern Neck of Virginia. Historical records illustrate that a number of unrelated free, indentured, and enslaved people lived in the same structure. Moreover, the building was an occasional meeting place for the county court, a place for religious worship, and operated as a place of trade with Native Americans.

Wood charcoal is often the most abundant material collected in archaeobotanical samples, and is the result of burned wood. Identification of wood charcoal can reveal evidence of wood selection patterns for fuel wood and building materials. This paper presents identifications for a sample of wood charcoal, and also takes a deeper look at sampling methodology and strategies. Overall, this analysis works to identify and categorize the wood utilized by the individuals living at Coan Hall, while discussing the components of resource selection and environmental relationships.

Introduction

The archaeological work conducted at Coan Hall (44NB11) is using a combination of traditional and modern techniques. Wood charcoal analysis is a less traditional form of archaeological analysis. In many botanical assemblages, wood charcoal is the most abundant material recovered (Smart and Hoffman 1988:167). It is present in the archaeological record of nearly every site, regardless of the inhabitants' ethnicity, gender, religion, age, or nearly any other factor. Yet few archaeologists spend the time or resources necessary to identify wood charcoal and interpret its meaning. Through analyzing and identifying wood charcoal, I aim to identify relationships present between 17th-century colonists and the local environment at Coan Hall. In addition, I hope to discover whether the samples correlate with expected results regarding wood selection for fuel wood and building materials. Furthermore, I explore the effect of various sampling strategies in regard to wood charcoal extraction and identification rates.

A Brief History of Coan Hall

Coan Hall was the plantation and manor home of John Mottrom and his family. Around 1640, John Mottrom settled on land adjacent to the Chicacoan leader's village (Heath 2016:10). Like many early colonists, Mottrom chose land formerly occupied by a Native American village

(Potter and Waselkov 1994:23). Mottrom was one of the first European settlers on the Northern Neck of Virginia. His large home at Coan Hall became a meeting place for the county court, trade, and religious worship (Haynie 1959:63; Heath 2016:10). Mottrom was closely allied with a rebellious group of Marylanders and Virginians who overthrew the Maryland government in 1645. Historical accounts describe a diverse group of free, indentured, and enslaved people that cohabitated in the manor home until John Mottrom's death in 1655 (Haynie 1959:73). Coan Hall was abandoned from 1655 until the early 1660s when Mottrom's son and heir, John Mottrom II, returned, and was occupied by his heirs into the early 18th century (Haynie 1959:166; Heath et. al 2016:19).

Recent Excavations at Coan Hall

Recent excavations and analysis by Dr. Barbara Heath and students from the University of Tennessee, Knoxville are expanding on the work done by Stephen Potter in 1970s and shedding light on life in 17th-century colonial Virginia. A myriad of features and structures have been located using a combination of surface collection, systematic-shovel test survey, area excavations, and geophysical survey (Heath et al. 2016:16). Current research is working to identify, date, and understand the construction and abandonment of the post-in-ground manor house and the surrounding features associated with Mottrom's occupation (Heath 2016:33). This project is a continuation of that research. The analyzed samples were recovered from a pit feature located northwest of the manor house, various layers of the cellar fill, plow zone, a post mold, and a feature west of the cellar that is cut through by the cellar fill.

Table 1. Unit and layer context key.

Unit and Layer	Context
603H-J, 605H-L, 605P-R	Cellar fill layers
582D	Post mold
601A, 624A	Plow zone
611G	Feature cut by cellar layers
624D-G	Pit feature fill layers

Sampling Collection Methods

The 45 wood charcoal samples analyzed for this project were recovered through waterscreening, floatation, and dry screening or in situ excavations (Figure 2). The majority of floatation samples had a volume of 5 liters. During floatation, heavy fraction samples were collected using 1/16 in. mesh and light fraction samples were collected using less than 0.1 mm mesh. Twenty-five percent of sediment excavated from contexts 572C, 585C, 603H-J, 605H-L, and 611G was waterscreened using 1/16 in. mesh. Due to the large volume of fill in the lower cellar layers, approximately 6% of sediment excavated from contexts 605P to 605Q was also waterscreened through 1/16 in. mesh. Samples selected for waterscreening had a volume of 2.5 liters. The handpicked wood charcoal samples were recovered in situ and during dry screening. The recovered charcoal provides data for scholars across academic disciplines to investigate human and environmental relationships.

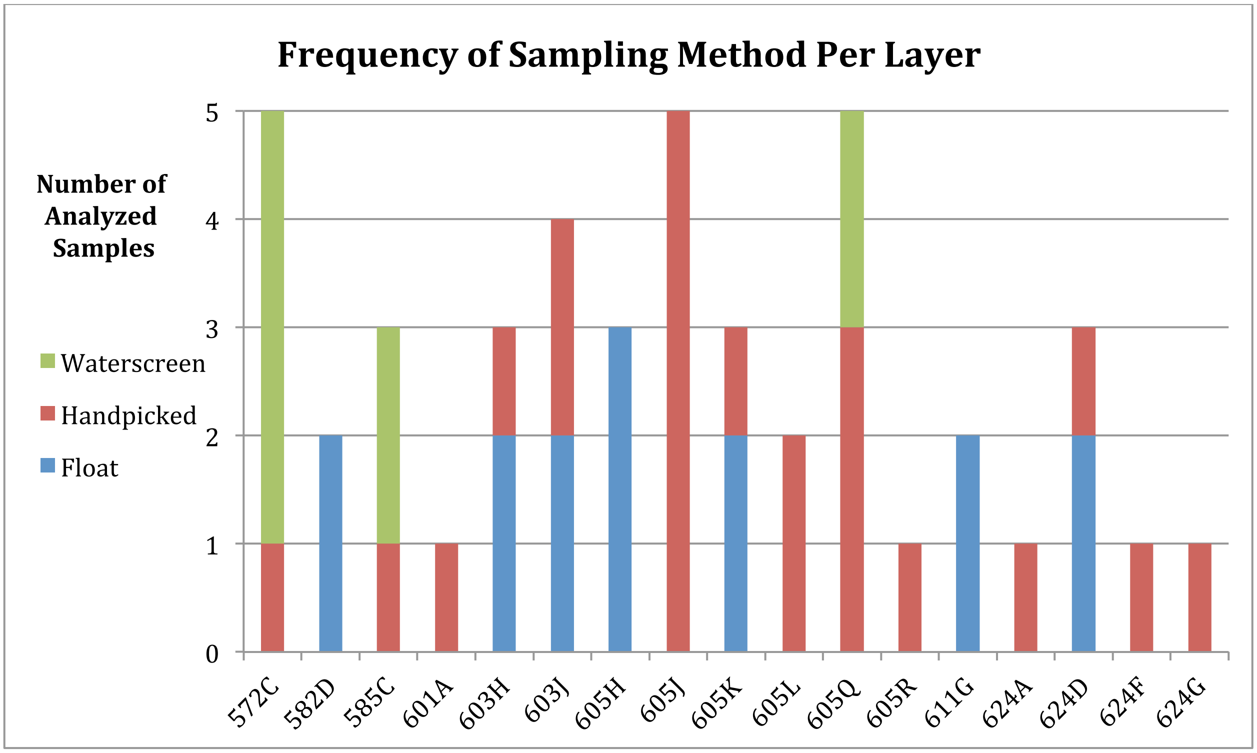


Figure 1. Frequency of analyzed samples and sampling methods by unit and layer for this study.

Romanticizing the Environment Across Disciplines

Despite historical ecology having a long tradition in Europe, this field is less discussed among New World ecologists (Hammett 1992:121; Szabó 2015:1005). Historical literature and research commonly portray the prehistoric landscape in North America as unaltered or virgin, but this concept is far from reality. Instead, for countless generations, Native Americans were tending and manipulating the landscape both actively and passively (Cowdrey 1983:54; Hammett 1992:128; Abrams and Nowacki 2008:1124). Likewise, in "Landscape History and Ecological Change," Norman Christensen (1989:116) explains that North American ecologists for decades have fallen into similar pitfalls of focusing upon "natural" and undisturbed ecosystems. In the years since Christensen's call for historical ecologists, climate change has inspired research investigating human and environmental relationships. Since 1997, an increase in publications defining themselves as historical ecology have been recorded (Szabó 2015:1010).

Despite a rise in popularity, Péter Szabó (2015:997) highlights the fact historical ecology lacks a traditional publication forum, a specialized institutional background, and unified methodology.

An Anthropogenic Environment

Nine thousand years ago, an ecological transition occurred as oak replaced pine as the most dominant taxa in the Eastern Woodlands in part due to the onset of Holocene climactic conditions (Abrams 1992:346). A variety of factors facilitated oak expansion, including anthropogenic burning and climate change which resulted in a warmer, drier environment (Abrams 1992:346; Delcourt and Delcourt 1997:1010). Native Americans actively maintained trees that provided nuts, including oak, hickory, walnut, and chestnut (Maxwell 1910:97; Abrams and Nowacki 2008:1124). Historical accounts from early settlers describe Native Americans purposefully setting fire to the forests (Maxwell 1910:73; Hammett 1992:128; Orwig and Abrams 1994:1221). Scholars in the early 20th century erroneously believe that had European arrival and intervention not occurred, the Eastern Woodlands of North America would have become a vast pastureland or desert due to Native American land management techniques involving fire (Maxwell 1910:103). Fires are believed to have encouraged more fire resistant oaks while controlling the population of species like beech, maple, dogwood, and gum (Orwig and Abrams 1994:1221; Delcourt and Delcourt 1997:1012). Scholars today consider historical fire suppression to be responsible for decreased regeneration in oak and certain types of pine (Nowacki et al. 1990:276; Delcourt and Delcourt 1997:1010).

Sources of Wood Charcoal

Forests, woodlands, and individual trees are managed to sustain resources or cleared to provide space for living, construction, agriculture, and roads (Reitz and Shackley 2012:231). Colonists cleared trees more often for domestic needs than for trade (Cowdrey 1983:54).

Oftentimes, wood charcoal is the most abundant botanical remain in macrobotanical assemblages (Pearsall 1989:155). Through analyzing and identifying wood charcoal archaeologists can identify selection patterns in building materials and fuel wood. Burned wood can also be evidence of trash disposal, funerary rituals, wildfires, foodways, razed settlements, or environmental management (Dimbleby 1967:30; Reitz and Shackley 2012:231). In addition, wood charcoal analysis is useful for environmental reconstructions (Pearsall 1989:155; Reitz and Shackley 2012:231). Through studying wood charcoal, a variety of different populations and cultural practices can be compared, as practices like wood collection and use transcend gender and age in cultures throughout history (Morehart and Helmke 2008:62; Higman 2012:144).

Understanding Wood Anatomy

Understanding wood anatomy is a key factor in identification. The main functions of wood tissues are water dispersal and mechanical support (Dimbleby 1967:104). Waste materials are moved through the dead cells of the heartwood (Dimbleby 1967:106). Rays are responsible for the radial transport of materials through the wood from the center of the tree to the bark (Dimbleby 1967:106). Variability in wood anatomy is inevitable and has a variety of causes, both anthropogenic and natural, but variability will not alter the basic structure (Dimbleby 1967:107; Reitz and Shackley:244). Angiosperms, or hardwoods, are most easily identified by the presence of vessels, also known as pores (Pearsall 1989:157; Hoadley 1990:28; Reitz and Shackley 2012:246). By analyzing vessel size and distribution it is possible to categorize hardwoods as ring porous, semi-ring porous, and diffuse porous (Hoadley 1990:32). In ring porous wood, distinct layers of vessels are noticed (Figure 2). The vessels from the beginning of the growing season are larger than the vessels formed at the end of the growing season (Reitz and Shackley 2012:246). As seen in Figure 2, the diameters of the vessels in semi-ring porous wood shrink from the early wood to the late wood (Pearsall 1988:157; Reitz and Shackley 2012:246). Diffuse porous wood contains vessels that do not deviate in diameter (Figure 2). Gymnosperms, or softwoods, lack vessels, although some families of gymnosperms, including pines, spruces, larches, and Douglas-firs, have resin canals that transport resin to seal off damaged areas (Pearsall 1989:157; Hoadley 1990:20; Reitz and Shackley 2012:246). The arrangement of resin canals can be used to identify pines (Hoadley 1990:145). Understanding that some taxa are more easily identifiable than others is another component of wood identification (Dimbleby 1967:109; Hoadley 1990:106; Reitz and Shackley 2012:244). Oak is one of the easiest identifications to make due to its distinct arrangement of earlywood and latewood vessels and the presence of thick rays (Dimbleby 1967:109; Hoadley 1990:103). Many scholars recommend a conservative approach when attempting identification (Dimbleby1967:109; Pearsall 1989:165). Throughout the analysis I took a conservative approach when differentiating hardwood and softwood, characterizing vessel categories, and undertaking taxa identification.

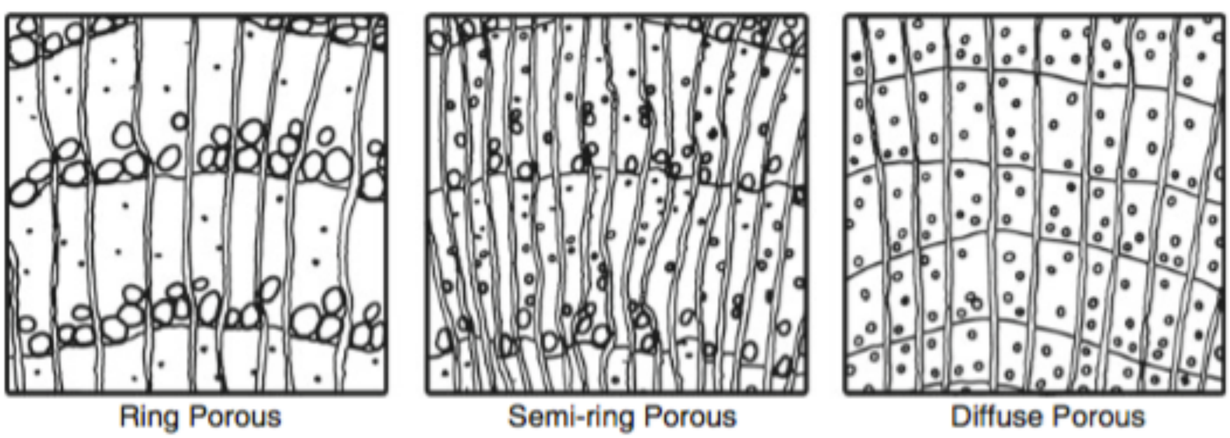


Figure 2. Vessel distribution and size as seen in the transverse sections of wood. From Pearsall (1988:157)

Methods

Samples were put through a two mm sieve. All pieces of wood charcoal larger than two mm were counted and weighed to the nearest hundredth of a gram. I consulted a variety of laboratory procedure texts and decided to set my predetermined standard count at 30 fragments, meaning, if the sample contained more than 30 fragments, I randomly selected 30 pieces of wood charcoal that were a variety of shapes and sizes (Dimbleby 1967:111; Pearsall 1988:115; Reitz and Shackley 2012:243). Purposefully selecting differing sizes and shapes was done for two reasons. First, random selection helps avoid a bias toward taxa that fragment in larger pieces (Dimbleby 1967:113; Hoffman and Smart 1988:174; Reitz and Shackley 2012:243; Pearsall 1989:165). Second, random selection provides an overall better representation of the entire assemblage; meaning random selection is a necessity for accurate statistical analysis. While counts were taken throughout this project, I believe the wood charcoal weight is more representative of the data (Pearsall 1989:117). Since some taxa are more fragile, relying solely on a count results in an underrepresentation of those more durable taxa. If samples were too dirty, or the transverse, tangential, or radial section was not visible, the specimen was snapped (Pearsall 1989:162; Hoadley 1990:192). Razor blades are used in ordinary wood cutting techniques, but the wood charcoal cells are too fragile for the pressure of the blade regardless of the blade’s sharpness (Hoadley 1990:192). The samples were viewed using a stereoscopic microscope. With guidance from paleoethnobotanist Dr. Kandace Hollenbach and wood anatomy texts (e.g., Hoadley 1990), I identified, counted, and weighed the samples to the nearest hundredth of a gram.

Results

Overall, I analyzed 45 samples of wood charcoal. In total, 82.10 g of wood charcoal (>2mm) were present in the samples. Of that I analyzed 70%, or 57.64 g (Table 2). Overall, seven different identifications were confidently made among the assemblage.

Table 2. Total weight and percentage by wood type.

	Analyzed Weight (g)	Percent of Total Weight Analyzed	Percent Indicating Presence Among Analyzed Samples
Hardwood	48.00	83.3%	98%
Softwood	6.37	11.1%	64%
Unidentified Wood	0.20	0.3%	9%
Residue	3.07	5.3%	87%
Total	57.64	100%	

Table 3. Total weight and percentage of hardwoods by vessel category.
*Ring Porous numbers do not include fragments identified as elm or hackberry, hickory, or oak.

	Weight (g)	Percent of Total Analyzed Weight	Percent Indicating Presence Among Analyzed Samples
Diffuse Porous	5.15	9%	14%
Ring Porous*	23.88	41%	66%
Semi-ring Porous	1.19	3%	3%
Unidentified Hardwood	6.04	10%	17%
Total	36.26	63%	

Table 4. Total weight and percentage and rate of appearance in analyzed samples of identified wood charcoal.

Taxa	Weight (g)	Percent of Total Analyzed Weight	Percent Indicating Presence Among Analyzed Samples
Elm or Hackberry	2.12	4%	11%
Hickory	0.89	2%	13%
Oak	8.73	15%	42%
Pine	1.61	3%	11%

Hardwood makes up 83% of the analyzed wood charcoal weight, 11% is softwood, and less than 1% is unidentified as either hardwood or softwood charcoal (Table 2). Residue weight accounts for the remaining 5% of the total analyzed weight. In this analysis, I am calling the collection of small charcoal particles that remained after handling and/or snapping residue. The residue weight is substantial due to the brittleness of wood charcoal. Of the hardwood, 74% can be identified as ring porous, 2% semi-ring porous, 11% diffuse porous, and 13% is unidentified hardwood. In some instances, samples that could not be differentiated between semi-ring porous and diffuse porous due to the fragments' sizes were counted in the diffuse porous category. Of the analyzed wood charcoal, 23% of the weight can be identified to a specific group. Overall, oak fragments make up 15% of the total wood charcoal weight analyzed. Oak is present in 44% of samples and in nearly half of the analyzed units. The two of the most abundant species in coastal Virginia, oak and hickory, combined to make up 17% of the identified wood charcoal by weight. The only softwood identified was pine, which is present in 11% of samples, and makes up 3% of the analyzed weight. Interestingly, pine was only identified in ER605, but was present throughout three different layers of ER605 (Appendix 1 and 3). I hope to recognize patterns regarding resource selection, through analyzing the types of wood charcoal present in various features and feature layers.

Pit (ER624D, F, and G)

Beneath the plow zone, ER624 contains a pit feature. During excavations the pit was divided into quadrants. The northeastern quadrant of the pit feature was composed of five layers and was 0.8 ft. in depth. Only one layer was excavated from the southwest quadrant of the pit feature. Of the analyzed samples, layers ER624D and G are from the northeastern quadrant, while layer F is from the southwestern quadrant. The wood charcoal assemblages of the layers ER624D, F, and G revealed that layer D contained a variety of wood species, but significantly more diffuse porous wood charcoal than layers F or G (Figure 3 and 4). The only type of wood charcoal recovered from layer G is unidentified softwood (Figure 3 and 4). Layer ER624F of the pit feature contains more diverse wood charcoal in comparison to layer G, and is similar in composition to layer D. (Figure 3 and 4). Currently, a definitive difference among the wood charcoal is not noticed between excavated quadrants. The *terminus post quem,* calculated by ceramic assemblages, for the pit feature is 1650, identifying this feature as potentially one of the earliest historic components to the site (Heath et al. 2016). It is important to keep the recovery method in mind when comparing samples. For instance, the wood charcoal collected from ER624F and G was handpicked and therefore is potentially less representative than layer D, whose wood charcoal was recovered by floatation and handpicking.

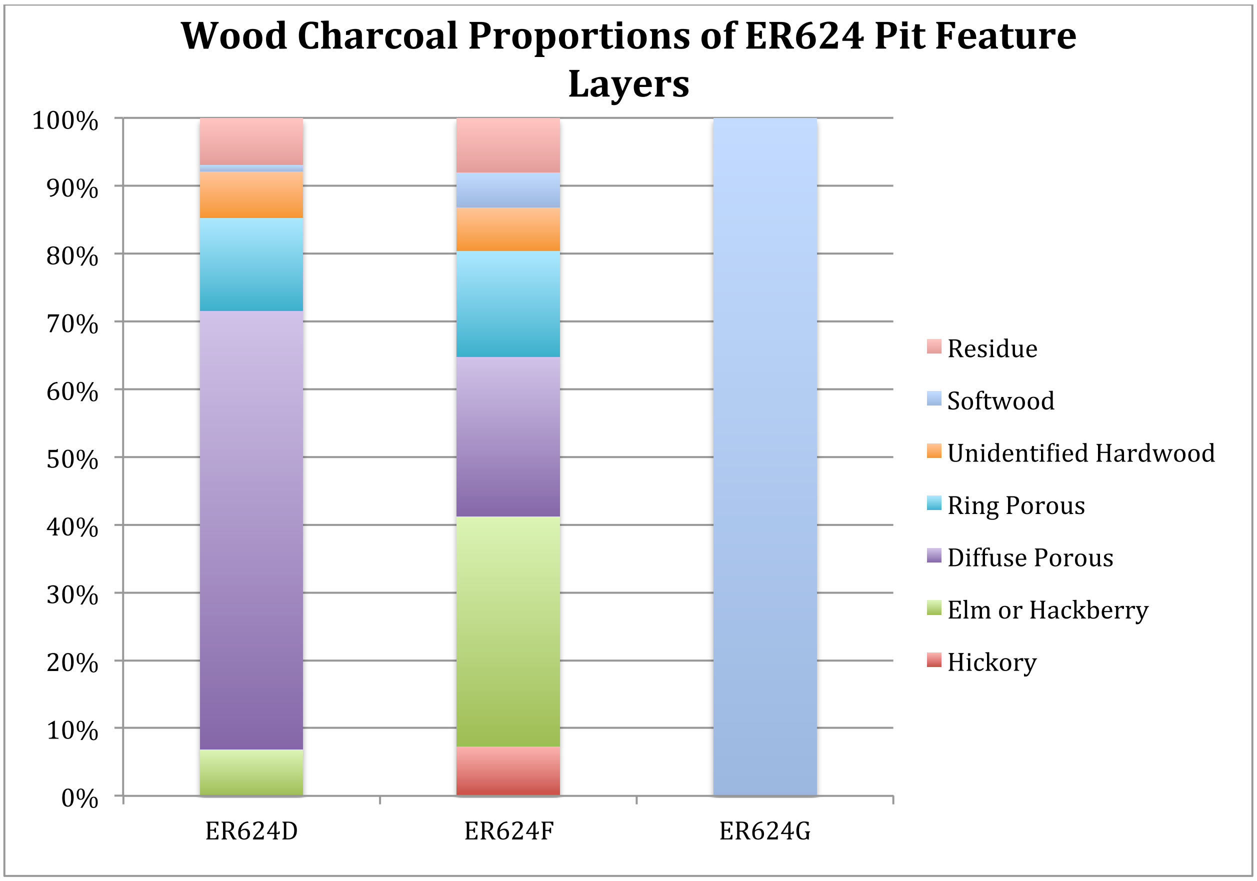


Figure 3. Wood charcoal proportions of the ER624 pit feature layers.

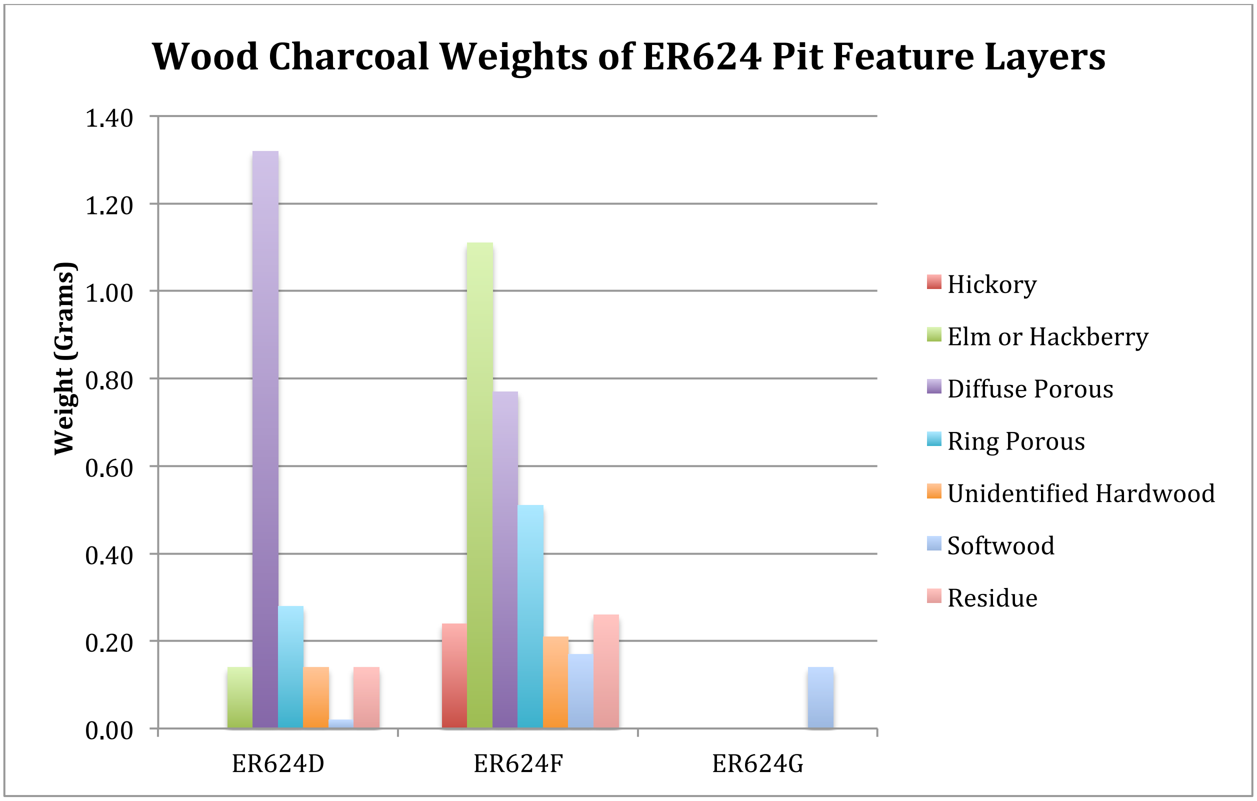


Figure 4. Analyzed wood charcoal weights of the pit feature in ER624.

Cellar (ER603H, J, and K & ER605H, J, K, L, Q, and R)

The *terminus post quem* and Binford date for the cellar indicate that it was filled in around the middle to late 1690s (Heath et al. 2016). The analyzed samples from the cellar are from three distinct episodes of deposition. Layers H and K are layers above a layer of oyster shell fill (Appendix 5). In units ER271, ER583, ER598, ER599, ER603, and ER605, layer J is the oyster shell layer (Appendix 5). The fill beneath the oyster shell in ER605 is composed of layers L, P, Q, and R (Appendix 5). Feature ER605S intrudes into layer R, but no wood charcoal samples from feature S were analyzed. Overall, each layer of the cellar is composed of a diverse assemblage of wood charcoal (Appendix 5; Figure 5). Oak is present throughout the analyzed cellar layers, although it is more abundant in the layers below the oyster shell fill (Figure 5 and 6). Elm or hackberry was found in every analyzed cellar layer except the layer above the oyster shell fill (Figure 5 and 6). The cellar layers below the layer of oyster shell fill display the majority the site's identified pine (Appendix 1, 4, 5; Figure 5 and 6). The wood charcoal present in the oyster shell layer and the layers below contain a higher percentage and combined weight of pine and other softwood fragments (Figure 5 and 6). It is currently unclear how and when the inhabitants at Coan Hall filled the cellar with layers of debris, but it is probable the cellar fill is associated with the descendants of Colonel Mottrom.

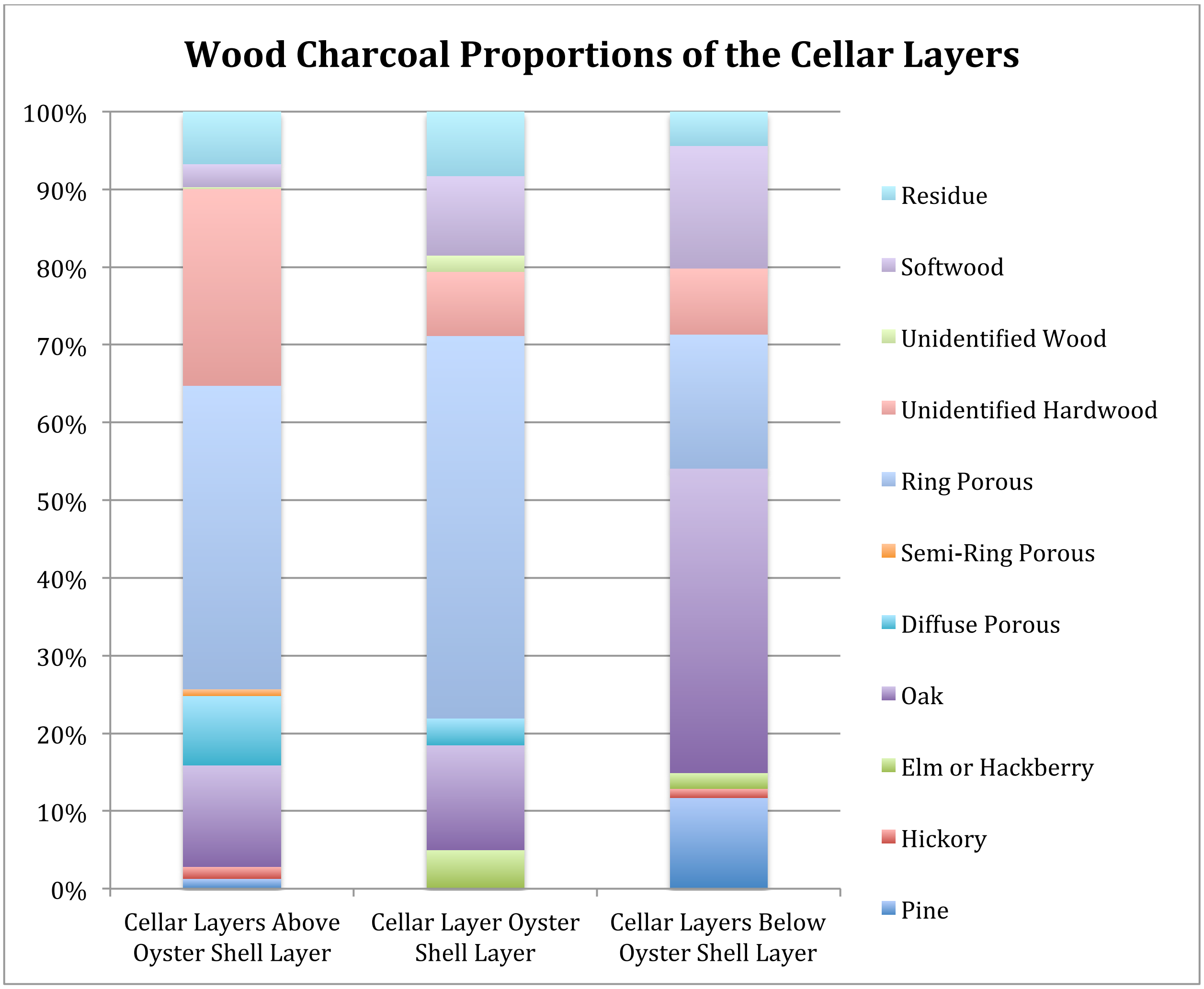


Figure 5. Wood charcoal proportions of the cellar layers.

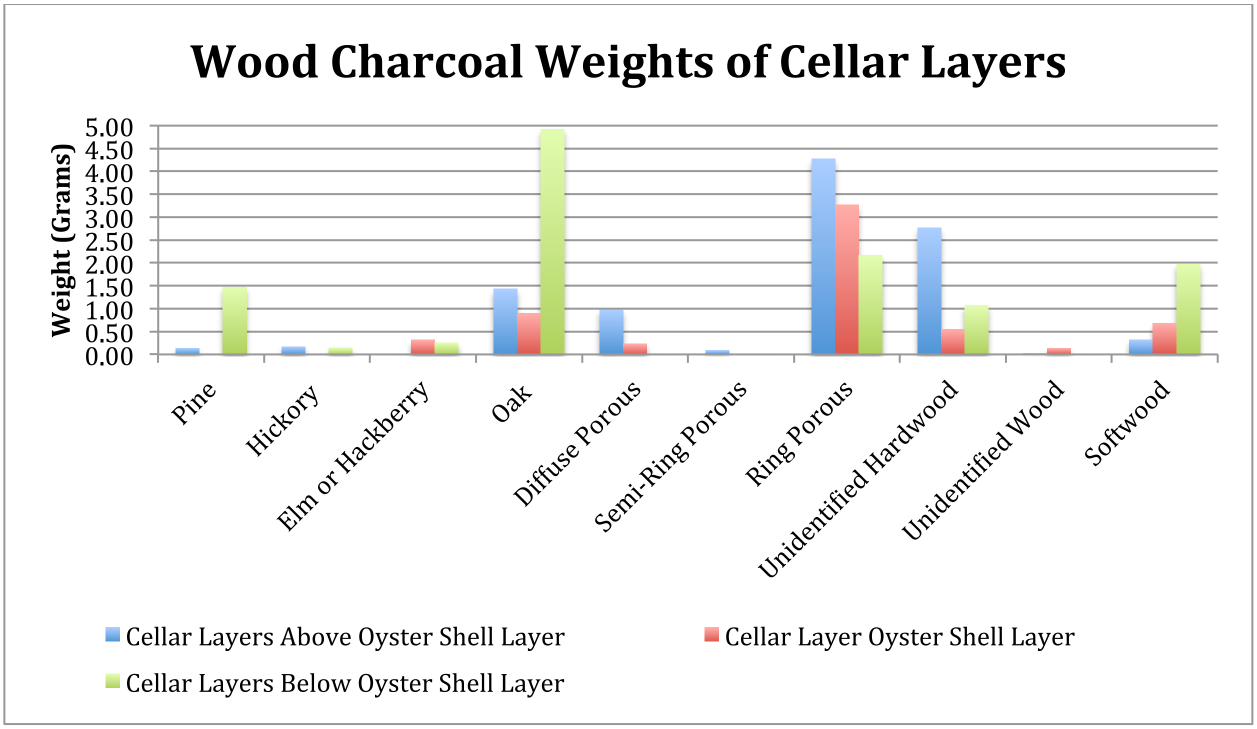


Figure 6. Identified wood charcoal weights by cellar layer.

Plow Zone (ER601A and ER624A)

Wood charcoal recovered from the plow zone layers of ER601 and ER624 was also analyzed. Plow zone is typically excavated at a depth of 0.6 to 0.8 feet. The fragments of ER601A included diffuse porous and ring porous wood charcoal. The weight and count for ER601 are relatively small when compared to other samples. ER624A was a larger sample in comparison to ER601 and is composed of a more diverse array of wood charcoal (Figure 7). It is probable the wood charcoal recovered from ER624A was originally from the pit feature previously discussed. The wood charcoal was likely disrupted by plowing.

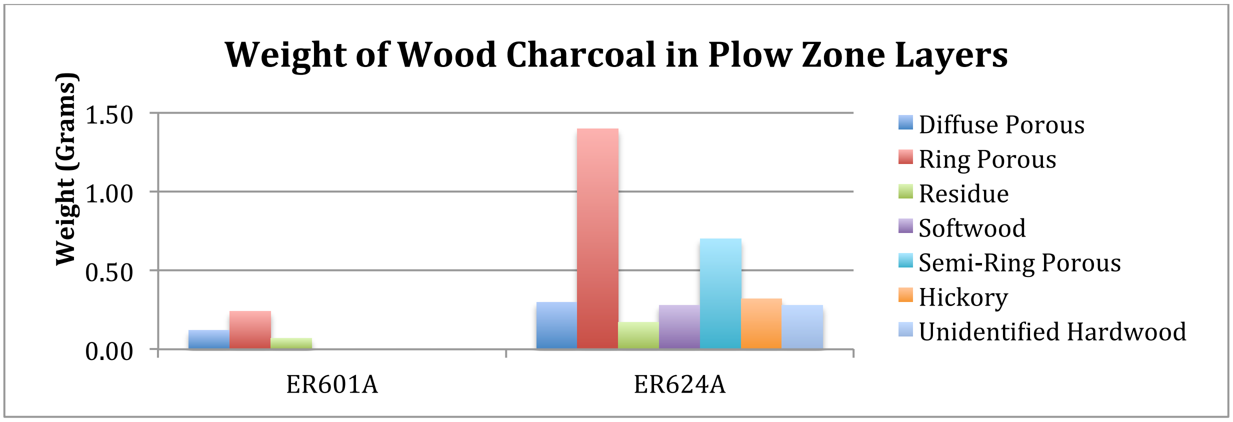


Figure 7. Weight of analyzed wood charcoal in plow zone layers.

Post Mold (ER582D)

ER582D is a post mold, measuring 2.205 ft. deep. The majority of the wood charcoal identified is a ring porous hardwood, although relatively small amounts of softwood, unidentified hardwood, diffuse porous, and semi-ring porous are present (Figure 8 and 9). It would be interesting to compare the wood charcoal from other post holes across the site. Colonists commonly preferred using hardwood for building purposes, so it is unsurprising the majority of wood charcoal is from a ring porous source.

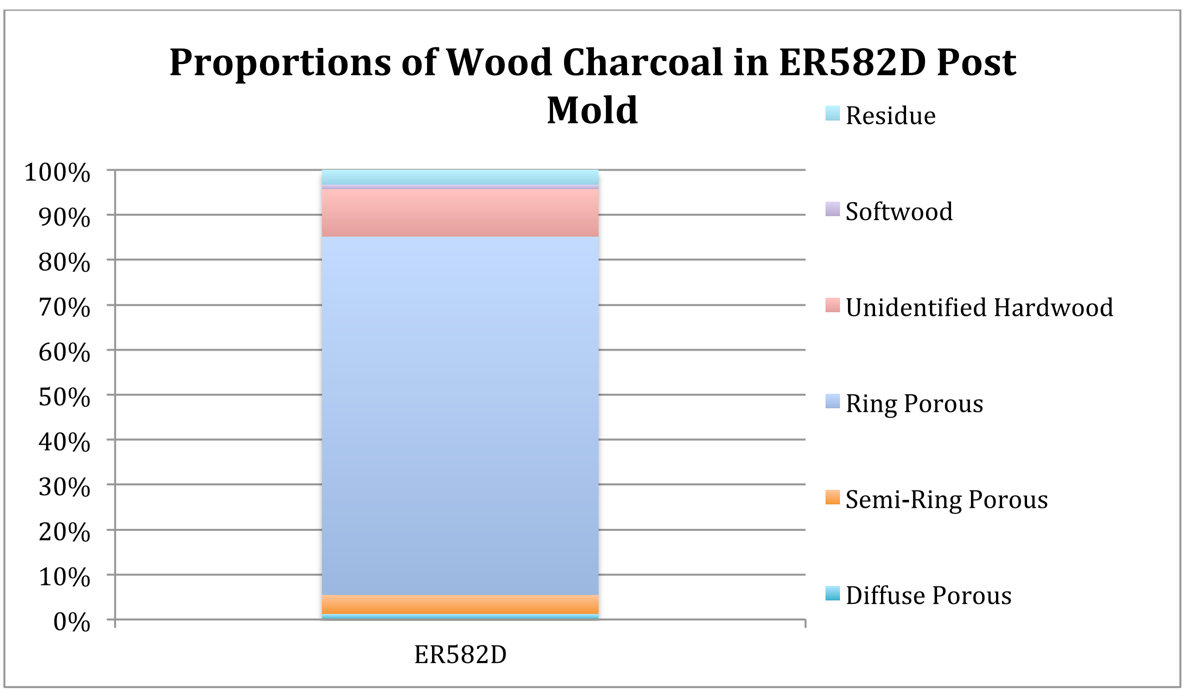


Figure 8. Wood charcoal proportions of ER582D.

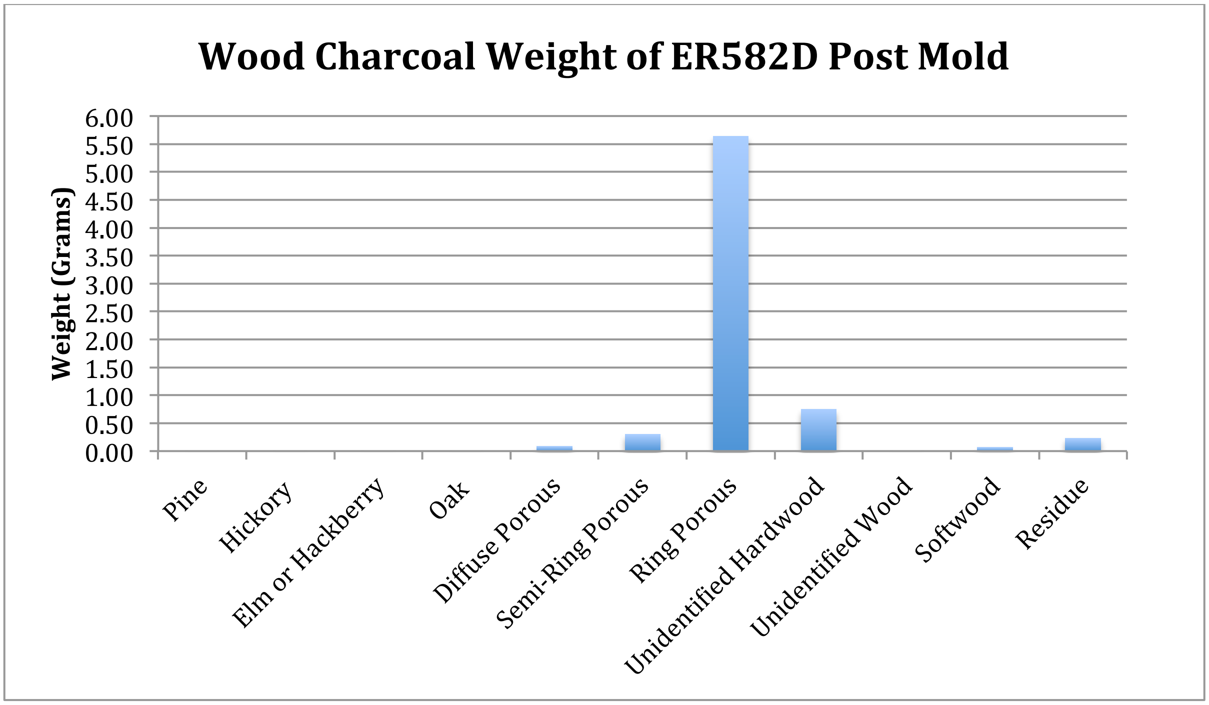


Figure 9. Analyzed wood charcoal weight from ER582D.

Feature Cut By Cellar Fill (ER611G)

ER611G contains a feature cut through by the cellar fill layers. The samples from ER611G were recovered by floatation and are the lowest in weight of any analyzed unit in this study (Appendix 1 and 4). The wood charcoal recovered is a combination of ring-porous, unidentified hardwood, and softwood. It is possible the wood charcoal recovered from ER611G is originally from the cellar.

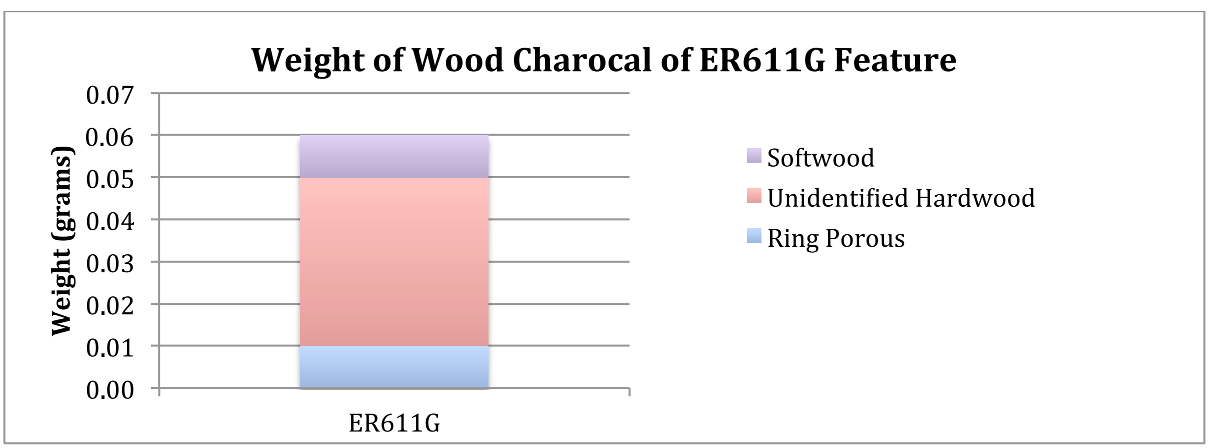


Figure 10. Analyzed wood charcoal weight from ER611G.

Discussion

Although scholars have written for decades that wood identification, especially wood charcoal identification, is not for the inexperienced, I believe that through learning the patterns of vessel distribution using a stereoscopic microscope archaeologists can quickly learn basic wood identification (Dimbleby 1967:108; Hoadley 1990:192; Reitz and Shackley 2012:244). Having no previous experience with wood identification prior to this project, I believe basic wood charcoal identification can be taught to any archaeologist or laboratory volunteer. By basic wood charcoal identification, I mean learning the skills to differentiate between hardwood and softwood, ring porous and diffuse porous hardwoods, and the skills to identify the more readily identifiable taxa like oak, hickory, and pine. The only materials necessary include a stereoscopic microscope with a high-intensity light source, wood charcoal (>2mm), and a scale (Pearsall 1989:115). Sorting experiments reported by Deborah Pearsall (1989:115) reveal analyzing wood charcoal smaller than 2mm did not produce a statistically significant difference in the wood charcoal total weight. Pearsall (1989:115) later states that when selecting a minimum sieve size preservation conditions must be individually evaluated.

Comparing Sampling Strategies

In floatation samples, the heavy fraction should be considered during analysis. There is not a statistically significant difference present in the number of taxa identified between the light and heavy fraction samples (Appendix 6). In statistical testing, increasing the number of computer run simulations, or permutations, will result in a more precisely estimated p-value. The estimated p-value is the percentage that the difference in a relationship between two variables occurred purely by chance. The typical p-value cut off for statistical significant is 0.05 or 5%. Even when increasing the number of permutations from 500 to 2000, the estimated p-value increases and the difference between the light fraction and heavy fraction shrinks, confirming the lack of a statistically significant difference between floatation fraction and number of taxa identified (Appendix 6). Moreover, the light fraction and heavy fraction samples are likely to produce similar weights of wood charcoal. The estimated p-value above 0.05 indicates that any difference in this relationship is not statistically significant (Appendix 7). If archaeologists are concerned with saving time or money, I recommend subsampling both the heavy and light fraction, instead of ignoring the heavy fraction. In reality, all botanical materials will not be separated into the light fraction during floatation. Due to soil composition, density, and other factors some plant materials will remain in the heavy fraction. Additionally, only analyzing the light fraction could result in an overrepresentation of the botanical remains with a lower density. Waterscreened samples typically recovered less wood charcoal when compared to floatation samples (Appendix 1). Furthermore, the waterscreened samples were not statistically more likely to have a fragment that could be identified to a specific taxon (Appendix 8). Samples recovered by floatation and extracted in situ typically weighed more than the waterscreened samples, but no difference was present among identification rates (Appendix 1 and 8). Waterscreening is potentially a damaging process for wood charcoal and other botanical materials, especially if clay is present (White and Shelton 2014:99). Although heavier and fewer in count, handpicked samples recovered were also not statistically more likely to yield identifiable fragments (Appendix 1 and 8). The p-values are greater than 0.05, indicating the relationship between the three samples types and the number of identified taxa does not encompass a statistically significant difference (Appendix 8). Overall, I recommend using a combination of floatation and in situ recovery for extracting wood charcoal. While waterscreening is a convenient option, if the archaeologist does not take care the process can damage the wood charcoal. Through selecting and utilizing appropriate extraction methods, archeologists are potentially able to reconstruct and comment upon cultural practices regarding the landscape (Reitz and Shackley 2012:231).

Which Trees Previously Covered the Landscape?

Prior to European arrival, hardwoods, mainly white oaks, red oaks, and hickory species, dominated Virginian forests (Orwig and Abrams 1994:1217; Abrams 2003:929). Today, those vegetative patterns continue in Virginian forests (Abrams 2003:930). Colonists considered lands containing hardwood forests to have superior soil to land overgrown with conifers (Cowdrey 1983:53). In his *Natural History of Virginia* (1940:24-35), William Byrd discusses the variety of oak species, softwood trees, and other plants present in Virginia and their uses. Carl Lounsbury used Byrd's account to support his theory that by the middle of the 18th-century colonists had developed a more comprehensive view of their environment. Historically, witness tree lists created by land surveyors highly favor white oak (Loeb 1987:420; Orwig and Abrams 1994:1220; Abrams 2003:927). In coastal Virginia, white oak grew well in moderately moist to drier environments (Abrams 2003:932). It is possible that red oak populations increased in pre-settlement and early post-settlement forests due to oak's ability to quickly resprout after logging and fire disturbances (Nowacki et al. 1990:277; Orwig and Abrams 1994:1221). Pine trees also quickly resprout after disturbances, but after a few decades are overtaken by hardwoods like oak and hickory (Abrams 1992:349).

Oak

Over six hundred oak species grow throughout the world (Mabberley 1987:324). Despite Native American practices, Europeans did not view acorns from oak trees to be worthy of human consumption. Oak was a preferred wood for construction, shipbuilding, wine barrels, smoking meat and fish, and fuel wood (Byrd 1940:25; Work Projects Administration 1941:283; Cowdrey

1983:53; Cronon 1983:109; Medve and Medve 1990:205; Lounsbury 2013:63). The high tannin content makes oak lumber less susceptible to insect and fungal damage (Dimbleby 1967:99; Beart et al. 1985:33). Moreover, oak was a popular construction material in the Old World, especially in England (Dimbleby 1967:109). Through continuing to select oak for 17th- and 18th-century construction, Europeans were staying connected to Old World traditions in a place where their expertise was challenged by unfamiliar flora and fauna (Cowdrey 1983:46). At Poplar Forest, Jessica Bowes and Heather Trigg (2012:163) also found the majority of their identified samples to be oak, which indicates that oak species continued to be heavily exploited into the 19th century.

Other Hardwoods

Additional hardwoods identified include hickory and elm or hackberry, although it is likely that ash, chestnut, persimmon, tulip poplar, birch, beech, and walnut are present among the samples (Delcourt et al.1984:16-50). Elm and hackberry feature a similar vessel arrangement, which is even more challenging to distinguish when analyzing small fragments (Hoadley 1990:104). William Byrd (1940:26) wrote that both Native Americans and English colonists in Virginia used elm to create baskets. Early colonists exported some hardwood varieties, like black walnut (Cowdrey 1983:52-53). Hardwoods are ideal fuel woods, especially for fires used to smoke meats and fish. For smoking, hardwoods with high sugar contents and long burning durations are preferred. The resin found in softwoods is known to foul the flavor of foods if used for smoking. Modern chefs favor recipes that burn oak, hickory, mesquite, pecan, and walnut. The higher percentage of hardwood present among samples supports the assumption that colonists preferred using hardwood for fuel wood and construction purposes. These results are supported by wood charcoal analyses completed at other sites (Trigg and Landon 2010:45; Bowes and Trigg 2012:167-168; Henderson 2013:52).

Softwoods

While hardwoods are more efficient fuel woods, pine was known to rapidly heat a fire (WPA 1941:283). Although softwoods burn quicker, they are easier to ignite than hardwoods. Pine was highly regarded for its low density, making it unsurprising that it was widely used in ship construction. Tall white pines were commonly used as ship masts. The significant growth of the British Navy correlates both with timber shortages in England and the rise in white pine exportation in Virginia in first decades of the 17th century (Cowdrey 1983:53). By the 1630s, the majority of lumbering exports originated in New England. Other softwoods, like cedar, were also commonly used in construction, especially as roof shingles and clapboards (Byrd 1940:28; Cronon 1983:112). Although pine was the only softwood identified, it is likely that different species of firs and cedars are present among the samples. Other macrobotanical analyses have taken conservative approaches toward softwood identification (Bowes and Trigg 2012:164; Henderson 2013:40). Throughout the Coan Hall samples, fragments of a particular softwood with a distinct coarse texture and few to no resin canals was frequently noticed. It is possible that the softwood is a type of cypress, cedar, or fir.

Conclusion and Further Directions

Overall, I found that hardwood more common among the analyzed samples. Softwood composed around 10% of analyzed weight and was present in the majority of samples (Appendix 2, Table 2). I was typically able to identify a fragment as either hardwood or softwood, which supports my belief that basic wood charcoal identification can be taught and utilized among archaeologists of all abilities. With additional wood charcoal analysis and a better understanding of the contexts at Coan Hall, understanding the changes in resource preference overtime is possible.

As mentioned earlier, it is likely other taxa are present in my samples. Pollen analysis from the Chesapeake area currently supports that assumption (Delcourt et al. 1984:16-54; Willard et al. 2003:208-210). Ideally, conducting pollen analysis at Coan Hall would offer more direct evidence. Historical records could offer limited assistance with identifying additional taxa. Scholars disagree to the extent colonists understood their environment. Environmental historian Albert Cowdrey (1983:46) describes colonists as naïve intruders in the New World. The nomenclature also presents a challenge when interpreting historical records. Colonists and early Americans frequently referred to New World taxa with Old World terms and colloquial nomenclature (Maxwell 1910:97; Cronon 1983:8; Loeb 1987:416). According to Robert Loeb (1987:414), relatively few colonial land records include witness trees. Instead, those documents tend to focus on the names of neighbors, water bodies, stakes, and rocks. Additionally, surveyors were poorly prepared, inaccurate, and dishonest (Roome 1883:8; Hughes 1979:196; Loeb 1987:416). According to Carl Lounsbury (2013:63), by the middle of the 18th century, construction contracts rarely mentioned the types of wood to be used, as colonists by this point understood the qualities of regional building materials. Instead, contracts emphasized using heartwood rather than sapwood (Lounsbury 2013:63). From my research it is unclear whether 17th-century construction contracts specifying wood species exist.

Overall, more research analyzing wood charcoal is needed. Meaningful cultural interpretations will not be made through only weighing wood charcoal. Analysis including identification and pattern recognition is necessary. Like all historical documents, documents regarding the environment are filled with bias. Oftentimes, historians and other scholars leave biases toward the environment unaddressed. While American ecologists are becoming more aware of how to better communicate about the unavoidable relationships between humans and the environment, interdisciplinary collaborations are still necessary (Christensen 1989:117). Interdisciplinary research involving scholars with expertise in archaeology, agriculture, biology, cultural anthropology, environmental sciences, forestry, geography, geology, history, religious studies, and sociology is needed. A better understanding of past environments and the relationships between humans and their environments will only benefit future generations. Furthermore, understanding that the environment is never static. How humans interacted with the environment is something a large portion of the population deserves to know.

Appendix 1

Wood Charcoal Counts and Weights

Sample Type	N	Total Count	Analyzed Count	Total Weight (g)	Analyzed Weight (g)
Flotation	15	2488	600	32.04	14.40
Waterscreened	8	92	92	7.16	7.16
Handpicked	22	428	347	42.90	36.08
Total	**45**	**3008**	**1039**	**82.10**	**57.64**

				Hardwood		Softwood		Unidentified Wood	
Feature/Level	Sample	Sample Type	Volume (L)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)
572C	157	Handpicked		9	2.44	3	0.12	0	0.00
572C	488	Waterscreen	2.5	15	0.91	2	0.03	0	0.00
572C	507	Waterscreen	2.5	8	0.85	2	0.01	1	0.03
572C	508	Waterscreen	2.5	7	0.31	0	0.00	0	0.00
572C	511	Waterscreen	2.5	11	0.90	0	0.00	0	0.00
582D	23	Float (HF/LF)	5.0	60	3.49	0	0.00	0	0.00
582D	24	Float (HF/LF)	5.0	57	3.29	3	0.07	0	0.00
585C	168	Handpicked		25	1.46	5	0.06	0	0.00
585C	479	Waterscreen	2.5	16	1.66	3	0.53	0	0.00
585C	481	Waterscreen	2.5	9	0.91	2	0.34	0	0.00
601A	140	Handpicked		4	0.36	0	0.00	0	0.00
603H		Handpicked		47	4.32	2	0.06	0	0.00
603H	8	Float (HF/LF)	5.0	54	0.60	6	0.11	0	0.00
603H	9	Float (HF/LF)	5.0	56	0.93	4	0.02	0	0.00
603J	12	Float (HF/LF)	5.0	47	0.81	8	0.07	5	0.03
603J	13	Float (HF/LF)	5.0	54	0.75	6	0.10	0	0.00
603J	57	Handpicked		3	1.19	0	0.00	0	0.00
603J	127	Handpicked		1	0.14	0	0.00	0	0.00
605H	3	Float (HF)	2.5	30	0.26	0	0.00	0	0.00
605H	4	Float (HF)	2.5	27	0.20	3	0.02	0	0.00
605H	5	Float (HF/LF)	5.0	42	0.39	2	0.01	3	0.03
605J	22	Handpicked		1	0.27	0	0.00	0	0.00
605J	60	Handpicked		5	0.29	0	0.00	0	0.00
605J	63	Handpicked		7	0.52	5	0.51	11	0.11
605J	66	Handpicked		9	0.99	0	0.00	0	0.00
605J	103	Handpicked		1	0.31	0	0.00	0	0.00
605K	26	Float (HF/LF)	5.0	54	1.05	6	0.02	0	0.00
605K	27	Float (HF/LF)	5.0	54	0.84	6	0.05	0	0.00
605K	59	Handpicked		16	1.13	5	0.17	0	0.00
605L	198	Handpicked		17	1.69	13	1.21	0	0.00
605L		Handpicked		11	1.86	0	0.00	0	0.00
605Q	144	Handpicked		19	0.98	11	0.80	0	0.00
605Q	151	Handpicked		14	2.24	2	0.11	0	0.00
605Q	210	Handpicked		8	0.38	0	0.00	0	0.00
605Q	482	Waterscreen	2.5	5	0.11	3	0.11	0	0.00
605Q	484	Waterscreen	2.5	5	0.17	3	0.04	0	0.00
605R	186	Handpicked		3	1.23	3	1.18	0	0.00
611G	16	Float (HF)	5.0	7	0.03	0	0.00	0	0.00
611G	17	Float (HF)	5.0	2	0.02	2	0.01	0	0.00
624A	124	Handpicked		24	3.00	6	0.28	0	0.00
624D	76	Float (HF)	5.0	1	0.14	0	0.00	0	0.00
624D	80	Float (HF)	5.0	1	0.14	0	0.00	0	0.00
624D	128	Handpicked		6	1.60	1	0.02	0	0.00
624F	134	Handpicked		24	2.84	6	0.17	0	0.00
624G	135	Handpicked		0	0.00	22	0.14	0	0.00
Total			**90**	**876**	**48.00**	**145**	**6.37**	**20**	**0.20**

Appendix 1

Wood Charcoal Counts and Weights

			Unidentified Hardwood		Ring Porous		Semi-ring Porous		Diffuse Porous	
Feature/Level	Sample	Sample Type	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)
572C	157	Handpicked	1	0.00	8	2.44	0	0.00	0	0.00
572C	488	Waterscreen	5	0.07	8	0.77	0	0.00	2	0.07
572C	507	Waterscreen	2	0.07	3	0.63	1	0.10	2	0.05
572C	508	Waterscreen	0	0.00	6	0.28	0	0.00	1	0.03
572C	511	Waterscreen	0	0.00	9	0.80	0	0.00	2	0.10
582D	23	Float (HF/LF)	9	0.18	37	2.92	11	0.30	3	0.09
582D	24	Float (HF/LF)	31	0.57	26	2.72	0	0.00	0	0.00
585C	168	Handpicked	9	0.09	15	1.35	0	0.00	1	0.02
585C	479	Waterscreen	0	0.00	11	1.03	0	0.00	5	0.63
585C	481	Waterscreen	0	0.00	7	0.79	0	0.00	2	0.12
601A	140	Handpicked	0	0.00	3	0.24	0	0.00	1	0.12
603H		Handpicked	19	1.32	26	2.92	0	0.00	2	0.08
603H	8	Float (HF/LF)	18	0.20	30	0.30	0	0.00	6	0.10
603H	9	Float (HF/LF)	18	0.21	30	0.58	0	0.00	8	0.14
603J	12	Float (HF/LF)	21	0.17	23	0.61	0	0.00	3	0.03
603J	13	Float (HF/LF)	27	0.33	12	0.22	0	0.00	15	0.20
603J	57	Handpicked	0	0.00	3	1.19	0	0.00	0	0.00
603J	127	Handpicked	0	0.00	1	0.14	0	0.00	0	0.00
605H	3	Float (HF)	20	0.14	10	0.12	0	0.00	0	0.00
605H	4	Float (HF)	9	0.06	14	0.12	0	0.00	4	0.02
605H	5	Float (HF/LF)	10	0.08	28	0.28	0	0.00	4	0.03
605J	22	Handpicked	0	0.00	1	0.27	0	0.00	0	0.00
605J	60	Handpicked	1	0.01	4	0.28	0	0.00	0	0.00
605J	63	Handpicked	3	0.04	4	0.48	0	0.00	0	0.00
605J	66	Handpicked	0	0.00	9	0.99	0	0.00	0	0.00
605J	103	Handpicked	0	0.00	1	0.31	0	0.00	0	0.00
605K	26	Float (HF/LF)	17	0.27	29	0.58	0	0.00	8	0.20
605K	27	Float (HF/LF)	28	0.29	16	0.23	1	0.09	9	0.23
605K	59	Handpicked	4	0.20	11	0.75	0	0.00	1	0.18
605L	198	Handpicked	5	0.36	12	1.33	0	0.00	0	0.00
605L		Handpicked	4	0.01	7	1.85	0	0.00	0	0.00
605Q	144	Handpicked	12	0.33	7	0.65	0	0.00	0	0.00
605Q	151	Handpicked	6	0.34	8	1.90	0	0.00	0	0.00
605Q	210	Handpicked	3	0.02	5	0.36	0	0.00	0	0.00
605Q	482	Waterscreen	1	0.01	4	0.10	0	0.00	0	0.00
605Q	484	Waterscreen	0	0.00	5	0.17	0	0.00	0	0.00
605R	186	Handpicked	0	0.00	3	1.23	0	0.00	0	0.00
611G	16	Float (HF)	5	0.02	2	0.01	0	0.00	0	0.00
611G	17	Float (HF)	2	0.02	0	0.00	0	0.00	0	0.00
624A	124	Handpicked	3	0.28	9	1.40	8	0.70	4	0.62
624D	76	Float (HF)	0	0.00	1	0.14	0	0.00	0	0.00
624D	80	Float (HF)	1	0.14	0	0.00	0	0.00	0	0.00
624D	128	Handpicked	0	0.00	3	0.28	0	0.00	3	1.32
624F	134	Handpicked	3	0.21	14	1.86	0	0.00	7	0.77
624G	135	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
Total			**297**	**6.04**	**465**	**35.62**	**21**	**1.19**	**93**	**5.15**

Appendix 1

Wood Charcoal Counts and Weights

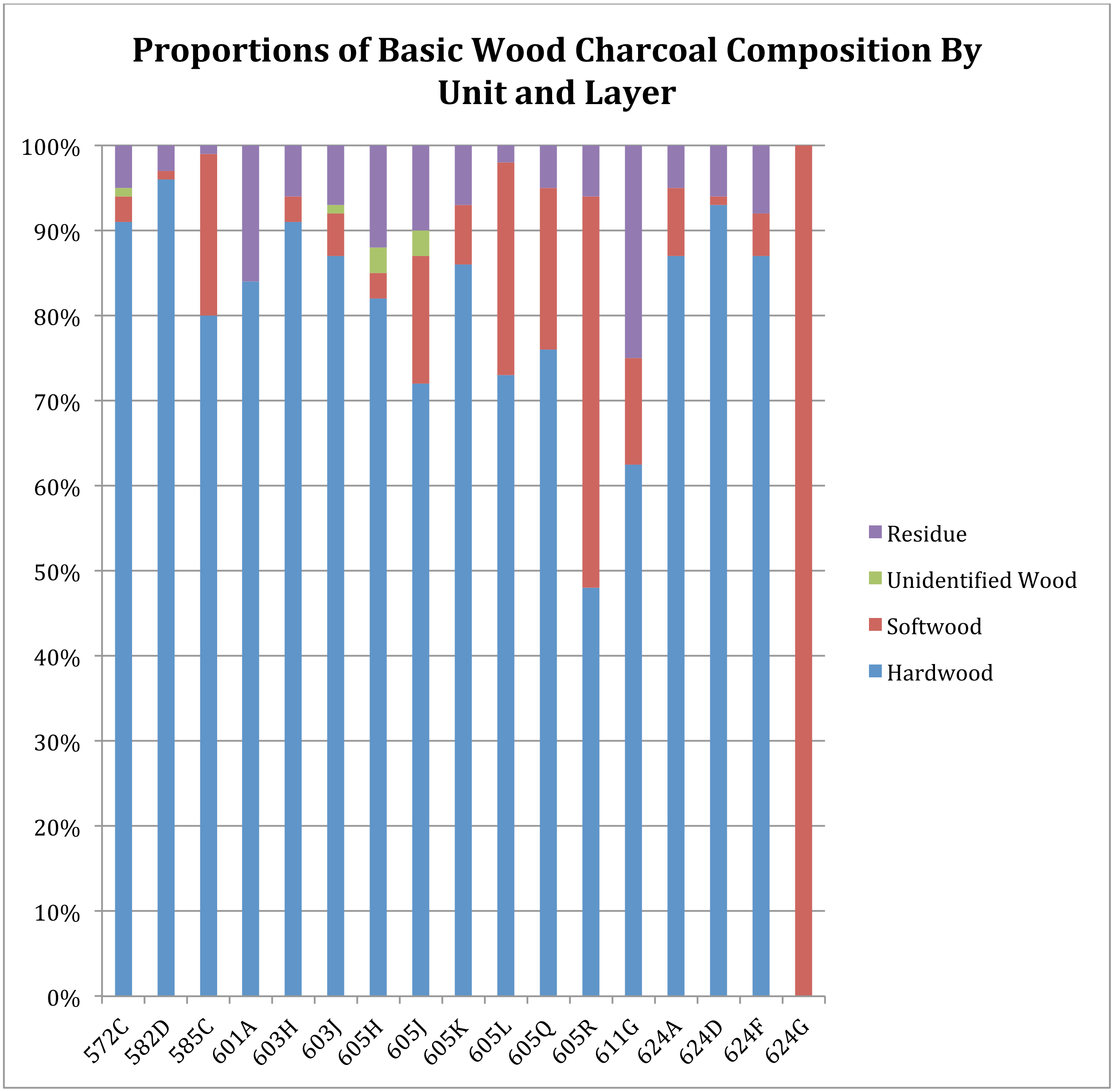
			Elm/Hackberry (*Ulmus/Celtis*)		Hickory (*Carya* sp.)		Oak (*Quercus* spp.)		Pine (*Pinus* spp.)	
Feature/Level	**Sample**	**Sample Type**	**Count**	**Weight (g)**	**Count**	**Weight (g)**	**Count**	**Weight (g)**	**Count**	**Weight (g)**
572C	157	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
572C	488	Waterscreen	0	0.00	0	0.00	1	0.04	0	0.00
572C	507	Waterscreen	0	0.00	0	0.00	1	0.10	0	0.00
572C	508	Waterscreen	0	0.00	0	0.00	0	0.00	0	0.00
572C	511	Waterscreen	0	0.00	0	0.00	0	0.00	0	0.00
582D	23	Float (HF/LF)	0	0.00	0	0.00	0	0.00	0	0.00
582D	24	Float (HF/LF)	0	0.00	0	0.00	0	0.00	0	0.00
585C	168	Handpicked	0	0.00	0	0.00	8	1.01	0	0.00
585C	479	Waterscreen	0	0.00	0	0.00	0	0.00	0	0.00
585C	481	Waterscreen	1	0.30	0	0.00	2	0.33	0	0.00
601A	140	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
603H		Handpicked	0	0.00	5	0.17	9	1.25	0	0.00
603H	8	Float (HF/LF)	0	0.00	0	0.00	0	0.00	0	0.00
603H	9	Float (HF/LF)	0	0.00	0	0.00	2	0.12	0	0.00
603J	12	Float (HF/LF)	0	0.00	1	0.01	1	0.14	0	0.00
603J	13	Float (HF/LF)	0	0.00	0	0.00	0	0.00	0	0.00
603J	57	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
603J	127	Handpicked	0	0.00	0	0.00	1	0.14	0	0.00
605J	22	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
605J	60	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
605J	63	Handpicked	0	0.00	0	0.00	2	0.09	0	0.00
605J	66	Handpicked	4	0.32	0	0.00	3	0.53	0	0.00
605J	103	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
605H	3	Float (HF)	0	0.00	0	0.00	0	0.00	0	0.00
605H	4	Float (HF)	0	0.00	0	0.00	3	0.04	0	0.00
605H	5	Float (HF/LF)	0	0.00	0	0.00	1	0.01	0	0.00
605K	26	Float (HF/LF)	0	0.00	0	0.00	0	0.00	0	0.00
605K	27	Float (HF/LF)	0	0.00	0	0.00	1	0.01	0	0.00
605K	59	Handpicked	0	0.00	0	0.00	0	0.00	3	0.14
605L	198	Handpicked	0	0.00	1	0.10	0	0.00	13	1.21
605L		Handpicked	0	0.00	0	0.00	7	1.85	0	0.00
605Q	144	Handpicked	0	0.00	3	0.05	3	0.10	0	0.00
605Q	151	Handpicked	2	0.25	0	0.00	3	1.37	2	0.11
605Q	210	Handpicked	0	0.00	0	0.00	3	0.25	0	0.00
605Q	482	Waterscreen	0	0.00	0	0.00	0	0.00	3	0.11
605Q	484	Waterscreen	0	0.00	0	0.00	1	0.12	3	0.04
605R	186	Handpicked	0	0.00	0	0.00	3	1.23	0	0.00
611G	16	Float (HF)	0	0.00	0	0.00	0	0.00	0	0.00
611G	17	Float (HF)	0	0.00	0	0.00	0	0.00	0	0.00
624A	124	Handpicked	0	0.00	3	0.32	0	0.00	0	0.00
624D	76	Float (HF)	1	0.14	0	0.00	0	0.00	0	0.00
624D	80	Float (HF)	0	0.00	0	0.00	0	0.00	0	0.00
624D	128	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
624F	134	Handpicked	9	1.11	3	0.24	0	0.00	0	0.00
624G	135	Handpicked	0	0.00	0	0.00	0	0.00	0	0.00
Total			**17**	**2.12**	**16**	**0.89**	**55**	**8.73**	**24**	**1.61**

Appendix 1

Wood Charcoal Counts and Weights

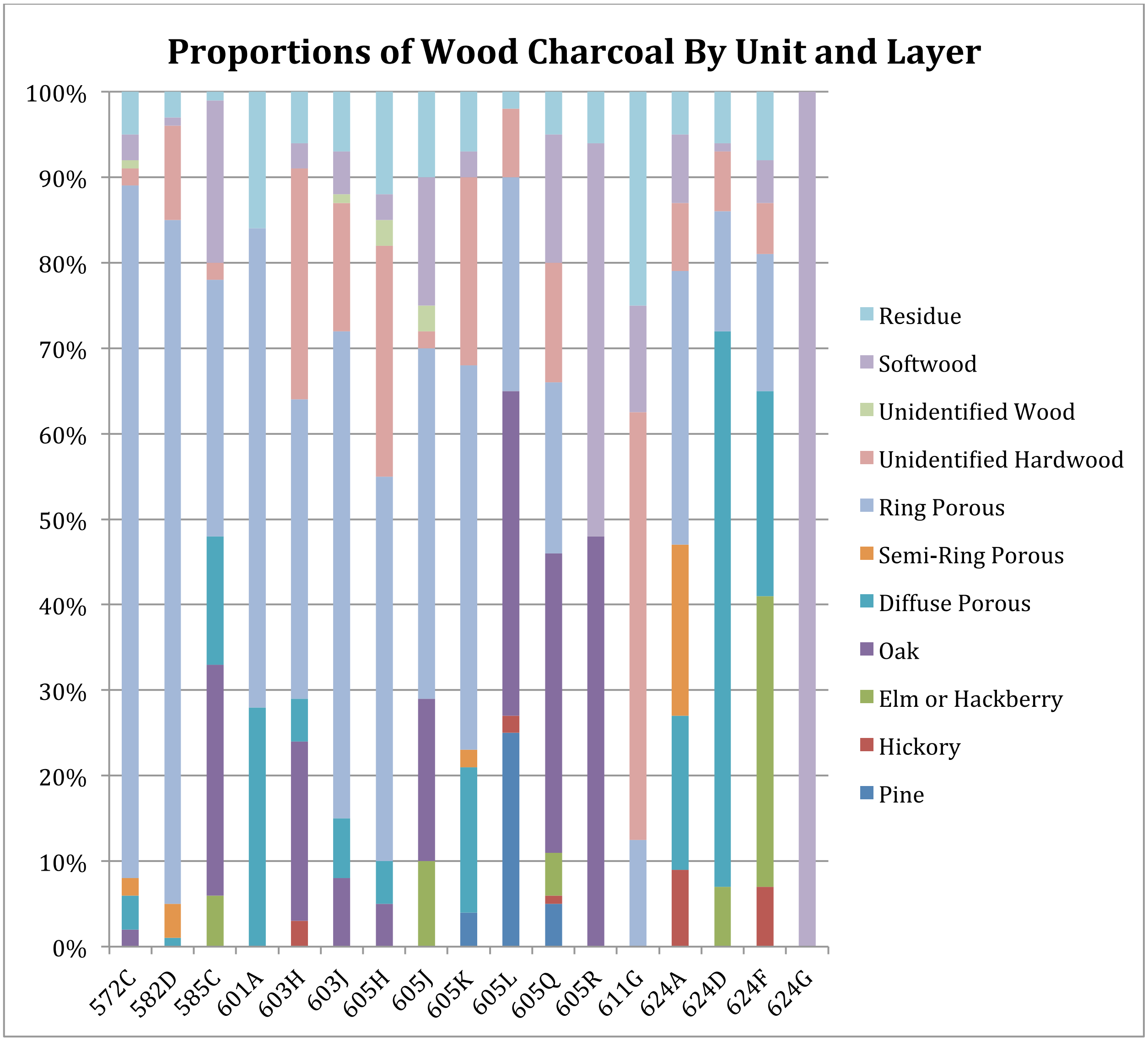
		White Oak Group		White Pine Group		Yellow Pine Group	
Feature/Level	Sample	Count	Weight (g)	Count	Weight (g)	Count	Weight (g)
572C	157	0	0.00	0	0.00	0	0.00
572C	488	0	0.00	0	0.00	0	0.00
572C	507	0	0.00	0	0.00	0	0.00
572C	508	0	0.00	0	0.00	0	0.00
572C	511	0	0.00	0	0.00	0	0.00
582D	23	0	0.00	0	0.00	0	0.00
582D	24	0	0.00	0	0.00	0	0.00
585C	168	0	0.00	0	0.00	0	0.00
585C	479	0	0.00	0	0.00	0	0.00
585C	481	0	0.00	0	0.00	0	0.00
601A	140	0	0.00	0	0.00	0	0.00
603H		0	0.00	0	0.00	0	0.00
603H	8	0	0.00	0	0.00	0	0.00
603H	9	0	0.00	0	0.00	0	0.00
603J	12	0	0.00	0	0.00	0	0.00
603J	13	0	0.00	0	0.00	0	0.00
603J	57	0	0.00	0	0.00	0	0.00
603J	127	0	0.00	0	0.00	0	0.00
605J	22	0	0.00	0	0.00	0	0.00
605J	60	0	0.00	0	0.00	0	0.00
605J	63	0	0.00	0	0.00	0	0.00
605J	66	0	0.00	0	0.00	0	0.00
605J	103	0	0.00	0	0.00	0	0.00
605H	3	0	0.00	0	0.00	0	0.00
605H	4	0	0.00	0	0.00	0	0.00
605H	5	0	0.00	0	0.00	0	0.00
605K	26	0	0.00	0	0.00	0	0.00
605K	27	0	0.00	0	0.00	0	0.00
605K	59	0	0.00	3	0.14	0	0.00
605L	198	0	0.00	0	0.00	0	0.00
605L		0	0.00	0	0.00	0	0.00
605Q	144	0	0.00	0	0.00	0	0.00
605Q	151	1	0.89	0	0.00	2	0.11
605Q	210	3	0.25	0	0.00	0	0.00
605Q	482	0	0.00	0	0.00	3	0.11
605Q	484	0	0.00	0	0.00	0	0.00
605R	186	0	0.00	0	0.00	0	0.00
611G	16	0	0.00	0	0.00	0	0.00
611G	17	0	0.00	0	0.00	0	0.00
624A	124	0	0.00	0	0.00	0	0.00
624D	76	0	0.00	0	0.00	0	0.00
624D	80	0	0.00	0	0.00	0	0.00
624D	128	0	0.00	0	0.00	0	0.00
624F	134	0	0.00	0	0.00	0	0.00
624G	135	0	0.00	0	0.00	0	0.00
Total		**4**	**1.14**	**3**	**0.14**	**5**	**0.22**

Appendix 2



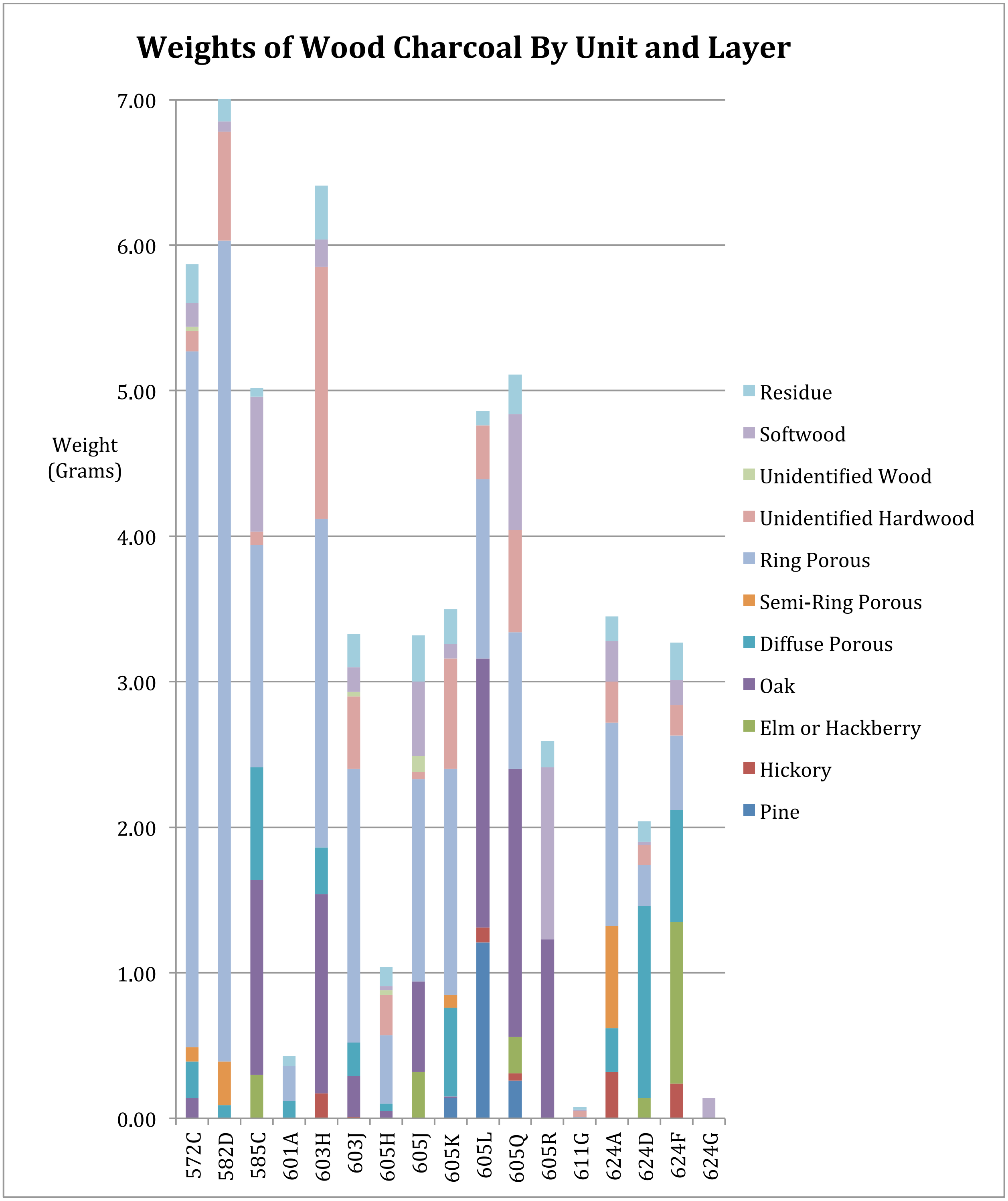
The chart above displays the proportions for basic identification for each analyzed unit/layer. In all layers, with the exception of ER624G, the majority of wood charcoal is hardwood. Overall, it was an infrequent occurrence to be unable to identify a fragment as either hardwood or softwood.

Appendix 3



In this chart the identifications are more specific than in Appendix 5. Every identification by proportion is displayed.

Appendix 4



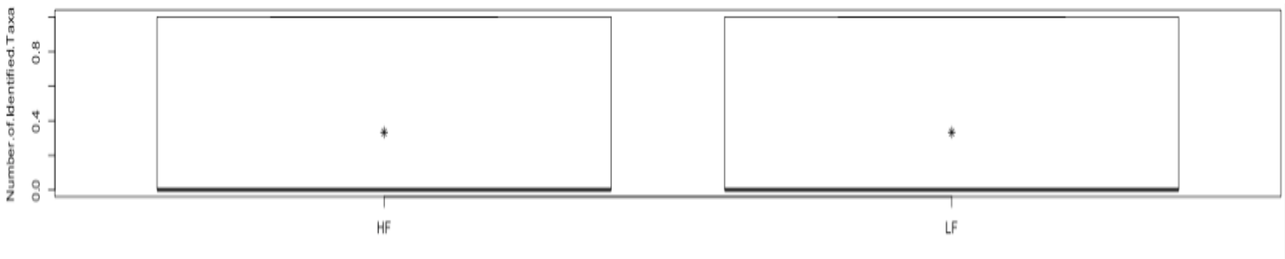
The total weights of analyzed wood charcoal are displayed in this chart by unit and layer. Every identification by weight per sample is displayed.

Appendix 5

Unit and Layer	Context
ER603H	Cellar Layer Above the Oyster Shell Layer
ER605H	Cellar Layer Above the Oyster Shell Layer
ER605K	Cellar Layer Above the Oyster Shell Layer
ER603J	Cellar Layer Oyster Shell Layer
ER605J	Cellar Layer Oyster Shell Layer
ER605L	Cellar Layer Below the Oyster Shell Layer
ER605Q	Cellar Layer Below the Oyster Shell Layer
ER605R	Cellar Layer Below the Oyster Shell Layer

Breakdown of unit, layer, and context in cellar feature

Appendix 6




```
                          Estimated p-value
Splitting into Categories                 1

With 500 permutations, we are 95% confident that the p-value (obtained by splitting
 Number.of.Identified.Taxa into categories) is between 0.993 and 1
                          Estimated p-value
Splitting into Categories                 1

With 2000 permutations, we are 95% confident that the p-value (obtained by splitting
 Number.of.Identified.Taxa into categories) is between 0.998 and 1
```

There is no difference statistically significant difference between the number of taxa identified between heavy floatation and light floatation samples. Even when increasing the number of permutations, the difference between light fraction and heavy fraction shrinks.

Appendix 7

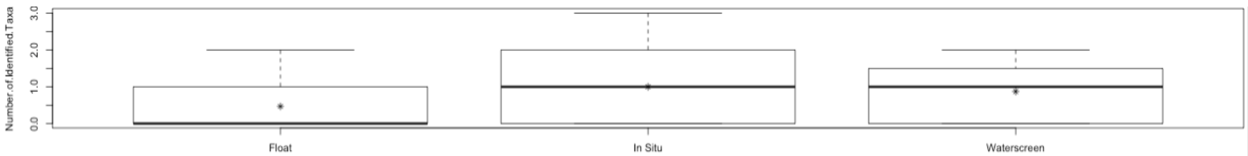

```
Analysis proceeds by grouping Total.Wood.Charcoal.Weight...2mm. into 2 categories:
0.04 to 0.83, 0.83 to 5.13

                        Estimated p-value
Splitting into Categories        0.08395802

With 2000 permutations, we are 95% confident that the p-value (obtained by splitting
 Total.Wood.Charcoal.Weight...2mm. into categories) is between 0.072 and 0.097
```

Despite the apparent difference in the mosaic plot, light fraction and heavy fraction samples are likely to produce similar weights of wood charcoal. The estimated p-value above 0.05 indicates that any difference in this relationship is not statistically significant. The difference in the plot is due to chance.

Appendix 8




```
Permutation procedure:
                      Float In Situ Waterscreen Discrepancy Estimated p-value
Averages (ANOVA)     0.4667       1       0.875       1.977             0.173
Mean Ranks (Kruskal)   13.2   26.87       33.12       3.581              0.18
Medians                   0       1           1        2.49             0.329
With 2000 permutations, we are 95% confident that
 the p-value of ANOVA (means) is between 0.157 and 0.19
 the p-value of Kruskal-Wallis (ranks) is between 0.163 and 0.198
 the p-value of median test is between 0.308 and 0.35
```

There is no difference statistically significant difference between the number of taxa identified and sample type. The estimated p-values indicate that the difference in the number of identified taxa among sample types in this analysis is due to chance.

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